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# Neuroradiology

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# NEURORADIOLOGY

## COMMENTARY

Technological developments have revolutionised the field of neuroradiology. Magnetic resonance imaging, multi-detector row computerised tomography and rotational angiography have all contributed significantly not only in detecting disease but also in helping us better understand the processes that lead to the causation of these diseases. Technological developments are not limited to imaging alone, but also have significant impact in the field of neuro-intervention. Stroke intervention and therapy is now becoming the norm, even in Pakistan.

A neuroradiology literature review covering the last three months reflects this. MR spectroscopy has the potential of revealing the biochemical make up of lesions. Although its application in diffuse brain diseases such as ischaemic encephalopathy is defined, its role in focal brain lesions has yet to be established. A systematic review carried out by Hollingworth et al has tried to address part of this issue. They concluded that although results in terms of characterising brain tumours were promising, the evidence was still not sufficient.

The role of interventional neuroradiology is growing, especially in the field of stroke management. Data from part 1 of the MERCI trail has been published. These results indicate that mechanical thrombolysis may be effective and safe even when IV thrombolysis has failed. Staying with the subject of intervention, two papers by Rooij et al testify to the procedural safety of coiling, both in ruptured and unruptured aneurysms.

Of particular local interest will be the article by Wattjes et al. While low field-strength MR scanners are sprouting all over the place and claiming to provide as good a diagnostic image as medium field-strength rivals, this article highlights there are important deficiencies of these machines. The comparison reported is between 1.5 and 3 Tesla scanners, but the data can very easily be extrapolated to 0.3 and 1.5 T machines as well. As they say in brain MR, what you don't see may be as important as what you see.

Kaskarelis and co-workers suggest that inferior petrosal sinus sampling be part of every work up for Cushing's syndrome. This may not be feasible in our setting but nevertheless highlights the role of this technique in equivocal cases.

And finally something that only radiologists seem to worry about: radiation dose. Even before the advent of MDCT (multi-detector CT), diagnostic imaging was the single largest contributor to the radiation burden on society. This is set to increase manifold with MDCT routinely using over 200 slices per examination. Cohnen et al's article is slightly reassuring as their calculated dose is only (!) 9.5 mSv. (Keep in mind that the average CT of the head done on a single slice machine gives a dose of about 1.5 mSv). Information obtained from the MDCT image is considerably better than from standard CT of the head, but there is a price to pay and this price is not just financial.

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## A SYSTEMATIC LITERATURE REVIEW OF MAGNETIC RESONANCE SPECTROSCOPY FOR THE CHARACTERIZATION OF BRAIN TUMORS

**BACKGROUND AND PURPOSE:** Proton MR spectroscopy (1H-MR spectroscopy) is a potentially useful adjunct to anatomic MR imaging in the characterization of brain tumors. We performed an updated systematic review of the evidence. **METHODS:** We employed a standardized search strategy to find studies published during 2002-2004. We reviewed studies measuring diagnostic accuracy and diagnostic, therapeutic, or health impact of 1H-MR spectroscopy. We abstracted information on study design, 1H-MR spectroscopy technique, and methodologic quality. We categorized studies into 5 subgroups: (1) metastasis versus high-grade tumor; (2) high-versus low-grade tumor; (3) recurrent tumor versus radiation necrosis; (4) tumor extent; and (5) tumor versus non-neoplastic lesion. **RESULTS:** We identified 26 studies evaluating diagnostic performance, diagnostic impact, or therapeutic impact. No articles evaluated patient health or cost-effectiveness. Methodologic quality was mixed; most used histopathology as the reference standard but did not specify blinded interpretation of histopathology. One large study demonstrated a statistically significant increase in diagnostic accuracy for indeterminate brain lesions from 55%, based on MR imaging, to 71% after analysis of 1H-MR spectroscopy. Several studies have found that 1H-MR spectroscopy is highly accurate for distinguishing high- and low-grade gliomas, though the incremental benefit of 1H-MR spectroscopy in this setting is less clear. Interpretation for the other clinical subgroups is limited by the small number of studies. **CONCLUSION:** The current evidence on the accuracy of 1H-MR spectroscopy in the characterization of brain tumors is promising. However, additional high-quality studies are needed to convince policy makers. We present guidelines to help focus future research in this area.

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## SAFETY OF MECHANICAL THROMBECTOMY AND INTRAVENOUS TISSUE PLASMINOGEN ACTIVATOR IN ACUTE ISCHEMIC STROKE. RESULTS OF THE MULTI MECHANICAL EMBOLUS REMOVAL IN CEREBRAL ISCHEMIA (MERCI) TRIAL, PART I

**BACKGROUND:** The MERCI (Mechanical Embolus Removal in Cerebral Ischemia) trial reported efficacy of the Merci Retriever for opening intracranial vessels in patients ineligible for intravenous (IV) tissue plasminogen activator (tPA). Patients who receive IV tPA but do not recanalize may also benefit from thrombectomy, but the revascularization efficacy and safety of this strategy has not been reported. **METHODS:** Multi MERCI is an ongoing international, multicenter, prospective, single-arm trial of patients with large vessel stroke treated within 8 hours of symptom onset. Patients were enrolled who had received IV tPA but did not recanalize or who were ineligible for IV tPA. Primary outcome was vascular recanalization (Thrombolysis in Myocardial Infarction [TIMI] score II/III) and safety. **RESULTS:** One hundred eleven patients received the thrombectomy procedure. Mean age ± SD was 66.2 ± 17.0 years, and baseline National Institutes of Health Stroke Scale (NIHSS) score was 19 ± 6.3. Thirty patients (27%) received IV tPA before intervention. Treatment with the Retriever alone resulted in successful recanalization in 60 of 111 (54%) treatable vessels and in 77 of 111 (69%) after adjunctive therapy (IA tPA, mechanical). Symptomatic intracranial hemorrhage (ICH) occurred in 10 of 111 (9.0%). Clinically significant procedural complications occurred in 5 of 111 (4.5%) patients. The symptomatic ICH rate was 2 of 30 (6.7%) in patients pretreated with IV tPA and 8 of 81 (9.9%) in those without (P > .99). **CONCLUSIONS:** Mechanical thrombectomy after IV tPA seems as safe as mechanical thrombectomy alone. Mechanical thrombectomy with both first- and second-generation Merci devices is efficacious in opening intracranial vessels during acute ischemic stroke in patients who are either ineligible for IV fibrinolytic therapy or have failed IV fibrinolytic therapy.

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## PROCEDURAL MORBIDITY AND MORTALITY OF ELECTIVE COIL TREATMENT OF UNRUPTURED INTRACRANIAL ANEURYSMS

**BACKGROUND AND PURPOSE:** To report morbidity, mortality, and angiographic results of elective coiling of unruptured intracranial aneurysms. **METHODS:** In a 10-year period, 176 unruptured aneurysms in 149 patients were electively treated with detachable coils. Seventy-nine aneurysms were additional to another ruptured aneurysm but were coiled more than 3 months after subarachnoid hemorrhage, 59 aneurysms were incidentally discovered and 38 aneurysms presented with symptoms of mass effect. Mean size of the 176 unruptured aneurysms was 10.6 mm (median, 8 mm; range, 2-55 mm). One hundred thirteen aneurysms (64%) were small (<10 mm), 44 aneurysms (25%) were large (10-25 mm), and 19 aneurysms (11%) were giant (25-55 mm). Thirty wide-necked aneurysms (17%) were coiled with the aid of a supporting device. **RESULTS:** Procedural mortality of coiling was 1.3% (2 of 149; 95% confidence interval [CI], 0.7-5.1%), and morbidity was 2.6% (4 of 149, 95% CI, 0.8-7.0%). The 4 patients with permanent morbidity were independent (GOS 4). Initial aneurysm occlusion was complete (100%) in 132 aneurysms, nearly complete (90%-98%) in 36 aneurysms, and incomplete (60%-85%) in 8 aneurysms. Six-month follow-up angiography was available in 132 patients with 154 coiled aneurysms (87.5%); partial reopening occurred in 25, mainly large and giant aneurysms (16.2%). Additional coiling was performed in 22 aneurysms and additional parent vessel occlusion in 1 aneurysm. There were no complications of additional treatments. **CONCLUSION:** Elective coiling of unruptured intracranial aneurysms has low procedural mortality and morbidity. For the management of unruptured aneurysms, endovascular treatment should be considered.

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## PROCEDURAL COMPLICATIONS OF COILING OF RUPTURED INTRACRANIAL ANEURYSMS: INCIDENCE AND RISK FACTORS IN A CONSECUTIVE SERIES OF 681 PATIENTS

**BACKGROUND AND PURPOSE:** To report the incidence of procedural complications of coiling of ruptured intracranial aneurysms leading to permanent disability or death in a consecutive series of 681 patients and to identify risk factors for these events. **PATIENTS AND METHODS:** Between January 1995 and July 2005, 681 consecutive patients with ruptured intracranial aneurysms were treated with detachable coils. Procedural complications (aneurysm rupture or thromboembolic) of coiling leading to death or neurologic disability at the time of hospital discharge were recorded. For patients with procedural complications, odds ratios (OR) with corresponding 95% confidence intervals (CI) were calculated for the following patient and aneurysm characteristics: patient age and sex, use of a supporting balloon, aneurysm location, timing of treatment, clinical condition at the time of treatment, and aneurysm size. **RESULTS:** Procedural complications occurred in 40 of 681 patients (5.87%; 95% CI, 4.2% to 7.9%), leading to death in 18 patients (procedural mortality, 2.6%; 95% CI, 1.6% to 4.2%) and to disability in 22 patients (procedural morbidity, 3.2%; 95% CI, 2.0% to 4.9%). There were 8 procedural ruptures and 32 thromboembolic complications. The use of a temporary supporting balloon was the only significant risk factor (OR, 5.1; 95% CI, 2.3 to 15.3%) for the occurrence of procedural complications. **CONCLUSION:** Procedural complication rate of coiling of ruptured aneurysms leading to disability or death is 5.9%. In this series, the use of a temporary supporting balloon in the treatment of wide-necked aneurysms was the only risk factor for the occurrence of complications.

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## DOES HIGH-FIELD MR IMAGING HAVE AN INFLUENCE ON THE CLASSIFICATION OF PATIENTS WITH CLINICALLY ISOLATED SYNDROMES ACCORDING TO CURRENT DIAGNOSTIC MR IMAGING CRITERIA FOR MULTIPLE SCLEROSIS?

**BACKGROUND AND PURPOSE:** Current MR imaging criteria for multiple sclerosis (MS) do not specify the magnetic field strength. The aim of this study was to investigate whether different MR imaging field strengths, specifically high-field MR imaging, have an impact on the classification of patients with clinically isolated syndromes suggestive of MS, according to MR imaging and diagnostic criteria. **METHODS:** In a prospective intraindividual comparative study, we examined 40 patients with clinically isolated syndromes (CIS) consecutively with a 1.5T and 3T MR imaging system, including axial sections of T2 turbo spin-echo, fluid-attenuated inversion recovery, and T1 spin-echo, before and after injection of gadolinium-diethylene-triaminepentaacetic acid. Constant resolution parameters were used for both field strengths. High-signal-intensity white matter lesions with a size of >3 mm were counted and categorized according to their anatomic location in infratentorial, callosal, juxtacortical, periventricular, and other white matter areas. Assessment of the fulfilled Barkhof MR imaging and McDonald diagnostic criteria was made separately for both field strengths in every patient. **RESULTS:** Eleven patients fulfilled more MR imaging criteria at 3T. Two of these patients fulfilled the criterion of dissemination in space (DIS) according to the first definition of McDonald criteria, which is based on imaging criteria alone. Another patient had DIS only at 3T, according to the second definition of the McDonald criteria including CSF parameters. **CONCLUSION:** MR field strength, specifically high-field MR imaging, has a substantial influence on the classification of patients with CIS according to imaging and a mild influence on the classification according diagnostic criteria for MS, leading to consequences for prognostic classification, imaging guidelines, and clinical trials.

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## BILATERAL INFERIOR PETROSAL SINUSES SAMPLING IN THE ROUTINE INVESTIGATION OF CUSHING'S SYNDROME: A COMPARISON WITH MRI

**OBJECTIVE:** Identifying the cause of Cushing's syndrome (CS) is a perplexing issue. Bilateral inferior petrosal sinuses sampling (BIPSS) is an invasive and elaborate but established procedure in distinguishing Cushing's disease (CD) from ectopic adrenocorticotropic hormone (ACTH) syndrome. We compare the diagnostic performance of BIPSS and MRI in detecting an ACTH-secreting source, and we suggest the diagnostic protocol that we found beneficial for the management of patients with CS. **MATERIALS AND METHODS:** Seventy-eight consecutive patients with CS were included. All patients underwent biochemical investigation and pituitary MRI. Consequently, patients were routinely referred for BIPSS; 25 received stimulation with corticotropin-releasing hormone (CRH) and 53 with CRH and desmopressin. The diagnosis of CD was established on the basis of complementary biochemical, imaging, and BIPSS criteria. The diagnostic performances of BIPSS and MRI were calculated for patients with final diagnosis. **RESULTS:** A final diagnosis was available for 54 patients (46 CD confirmed, five ectopic confirmed, three adrenals). No (known) patient was misclassified based on our suggested diagnostic criteria. MRI rendered 25 false-negatives and two false-positives (incidentalomas). Successful BIPSS yielded two false-negatives and three false-positives (adrenals). The calculated accuracy for detecting a pituitary source of ACTH was 50% and 88% for MRI and successful BIPSS, respectively.

**CONCLUSION:** MRI is of only limited diagnostic performance, while BIPSS is the most accurate way to establish the diagnosis of CD. The routine use of a multimodality diagnostic approach including BIPSS, MRI, and biochemical tests is suggested to avoid the risk of mismanagement for patients with CS.

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## RADIATION EXPOSURE OF PATIENTS IN COMPREHENSIVE COMPUTED TOMOGRAPHY OF THE HEAD IN ACUTE STROKE

**BACKGROUND AND PURPOSE:** To assess patient radiation exposure in comprehensive stroke imaging using multidetector row CT (MDCT) combining standard CT of the head, cerebral perfusion (CTP), and CT angiography (CTA) studies. **METHODS:** Examination protocols for CT and CTA of cerebral and cervical vessels, as well as CTP were simulated using a Somatom Sensation Cardiac 64. Effective doses were derived from measurements with the use of lithium-fluoride thermoluminescent dosimeters (LiF-TLD) at several organ sites using an Alderson-Rando phantom. **RESULTS:** LiF-TLD measurements resulted in effective doses of 1.7 mSv for CT, 1.9 mSv for CTA of intracranial vessels, and 2.8 mSv for CTA of cervical vessels, respectively. Depending on examination parameters, effective doses varied between 1.1 and 5.0 mSv for cerebral CTP. For CTP, local doses in the area of the primary beam ranged between 114 and 444 mGy. **CONCLUSIONS:** Comprehensive stroke imaging may result in up to 9.5 mSv with possible local doses of 490 mGy. Although critical doses for organ damage (eg, cataract formation or hair loss) are not reached, physicians need to be aware of possible radiation induced sequelae particularly in repetitive examinations.